eISSN 2255-0569

ORIGINAL

Comparion between General and Spinal Anesthesia for Lumbar Disc Surgery: A Randomized Clinical Trial

Comparación entre anestesia general y raquídea para la cirugía discal lumbar: Un ensayo clínico aleatorizado

Molouk Jaafarpour[1], Masoud Hatefi[2], Aminollah Vasigh[3], Ali Khani[4], Fatemeh Njafi[4], Elham Shafiei[5]

1. Department of Midwifery, School of Nursing and Midwifery Faculty, Ilam University of Medical Sciences, Ilam, Iran.
2. Department of Neurosurgery, Medicine Faculty, Ilam University of Medical Sciences, Ilam, IR-Iran.
3. Department of Anaesthesiology, Medicine Faculty, Ilam University of Medical Sciences, Ilam, Iran.
4. Department of Nursing, Nursing & Midwiferay Faculty, Ilam University of Medical Sciences, Ilam, Iran.
5. Department of Epidemiology, School of Health, Ilam University of Medical Sciences, Ilam, Iran.

Corresponding author
Masoud Hatefi
E-mail: hatefimasoud191@gmail.com

Received: 11 - I - 2023
Accepted: 13 - III - 2023

doi: 10.3306/AJHS.2023.38.04.41

Abstract

Introduction: Lumbar disc surgery is most often performed under general anesthesia (GA). However, spinal anesthesia (SA) can also be a successful alternative in lumbar disc surgery. The present study was conducted to compare the complications of general and spinal anesthesia in patients with lumbar discectomy.
Material and Methods: Fifty patients were randomly allocated into two groups of general (25 patient) and spinal anesthesia (25 patient). The pain severity (based on visual analogue scale [VAS]), the use of analgesics, blood pressure (BP), heart rate (HR), blood loss, respiratory rate (RR), patient satisfaction, nausea, vomiting, and shivering in recovery room were recorded.
Results: The mean pain severity score, postoperative use of analgesics, intraoperative blood loss and recovery time in the spinal anesthesia group were significantly lower than general anesthesia group (P<0.001). Intraoperative HR and BP changes, nausea, vomiting, and shivering in recovery room were significantly lower in spinal anesthesia group (p<0.05, p<0.001). The patient satisfaction was significantly high in the spinal anesthesia group (p<0.001).
Conclusions: spinal anesthesia is safe and seems to be more effective. Some advantages of SA include lower pain severity score and the use of analgesics, reduced amount of blood loss during the surgery and fewer postoperative complications.

Keywords: Anesthesia, Lumbar Surgery, Pain, Blood Loss.

Resumen

Introducción: La cirugía discal lumbar se realiza con mayor frecuencia bajo anestesia general (AG). Sin embargo, la anestesia raquídea (AC) también puede ser una alternativa satisfactoria en la cirugía discal lumbar. El presente estudio se realizó para comparar las complicaciones de la anestesia general y espinal en pacientes con discectomía lumbar.
Material y métodos: Cincuenta pacientes fueron asignados aleatoriamente a dos grupos de anestesia general (25 pacientes) y raquídea (25 pacientes). Se registraron la intensidad del dolor (según la escala analógica visual (EAV), el uso de analgésicos, la presión arterial (PA), la frecuencia cardiaca (FC), la pérdida de sangre, la frecuencia respiratoria (FR), la satisfacción del paciente, las náuseas, los vómitos y los escalofríos en la sala de recuperación.
Resultados: La puntuación media de la gravedad del dolor, el uso postoperatorio de analgésicos, la pérdida de sangre intraoperatoria y el tiempo de recuperación en el grupo de anestesia raquídea fueron significativamente inferiores a los del grupo de anestesia general (p<0,001). Los cambios intraoperatorios de la FC y la PA, las náuseas, los vómitos y los escalofríos en la sala de recuperación fueron significativamente menores en el grupo de anestesia raquídea (p<0,05, p<0,001). La satisfacción del paciente fue significativamente alta en el grupo de anestesia raquídea (p<0,001).
Conclusiones: la anestesia raquídea es segura y parece ser más eficaz. Algunas ventajas de la anestesia espinal son una menor puntuación de la intensidad del dolor y del uso de analgésicos, una menor pérdida de sangre durante la intervención y menos complicaciones postoperatorias.

Palabras clave: anestesia, cirugía lumbar, dolor, pérdida de sangre.

Background

Lumbar pain is the second major cause of consultation with physicians in the US and leads to the disability of at least 7 million people. The estimated cost of treatment for back pain is above $50 billion in addition to 93 million lost workdays in the year[1-5].

After lumbar herniation, lumbar laminectomy and discectomy with an annual statistics of 300,000 to 400,000 cases, is one of the most major surgeries with a prevalence of 10 to 40% in neurosurgery. These figures are reported to be about 13000 in the UK and over 250000 in the US[1,6-8]. Laminectomy can be performed under general anesthesia (GA) or spinal anesthesia (SA)[9,10]. However, GA is the most common method for lumbar disc surgery[10,11].

A safe anesthetic method should have characteristics such as maintaining stable hemodynamic, both rapid onset and reversal of effects, decreasing the length of stay in recovery room, reducing the demand for blood transfusion, postoperative pain, nausea, vomiting, and opioid use for analgesia[9,11]. However, recent studies show contradictory results and there is no single agreement for the appropriate anesthetic method in the lumbar disc surgery[12].

Objectives

The literature review indicated that there are controversial results regarding the effect of GA verses SA on laminectomy outcome[13]. Evidence shows that patients under spinal anesthesia have fewer complications and more satisfied compared to general anesthesia. This issue is consistent with the results of a number of conducted studies[14]. Previous researchers emphasized that further studies must be performed before reaching a unified conclusion. To the best of our knowledge, this study aimed to compare the outcomes of spinal versus general anesthesia in patients with lumbar laminectomy or discectomy.

Methods

Study protocol

This is a randomized controlled trial (RCT) performed at the one of the teaching hospitals affiliated to Ilam University of Medical Sciences (Imam Khomeini hospital).

Patient characteristics:

In this RCT, 50 patients aged 20-60 years with American Society of Anesthesiologist (ASA) physical status I or II who were scheduled for elective laminectomy or discectomy were enrolled in this study. The patients underwent either GA or SA.

Patients were randomly divided two groups of general or spinal anesthesia with 25 patients in each group using sealed envelopes technique. To avoid the effect of confounding variables, all procedures were performed with the same anesthesiologist and neurosurgeon.

Anesthesia procedure

Patients in GA group received 2-3 mg/kg intravenous propofol, 1-1.5 mcg/kg intravenous fentanyl, and0.6 mg/kg intravenous rocuronium bromide,2-3% sevoflurane and 50% N2O in O2 for maintenance of anesthesia. Ventilation mode: CMV, VT: 10 cc/kg, Breaths per minute: 12-14. Patients in SA group received 15 mg intrathecal bupivacaine 0.5% at L3 - L4 or L4 - L5 space in a sitting position (To prevent high spinal, we used 15 mg intrathecal bupivacaine for all patients with different height and weight). We used the Visual Analogue Scale (VAS) to determine severity of pain. The pain severity was assessed at 1, 4, 8, 12, and 24 hours after surgery. The patient's blood loss (during operation), mean blood pressure (BP), heart rate (HR), respiratory rate (RR), oxygen saturation (SPO2), urinary retention, and morphine consumption (IM) were recorded. NSAID according to patients need were administrated. The complications such as nausea, vomiting, and shivering in recovery room were recorded.

The exclusion criteria were contraindications to SA (such as patient's refusal, coagulopathy, infection at the needling site, and hypovolemia), severe spinal stenosis, history of cardiovascular disease, neuromuscular, seizure, or intracranial hypertension, renal or metabolic disease, bleeding abnormalities and drug or alcohol abuse.

Ethical Consideration

This study is approved under the ethical approval code of (IR. MEDILAM.RE.1394.39) and informed written consent was obtained from all subjects. Clinical Trial Code: (IRCT2015062222870N1) .

Validity and Reliability

Content validity was applied to assign the validity of the questionnaire. Cronbach's alpha test was applied to assign the reliability of questionnaire. The reliability of the questionnaire was 0.89.

Statistical analysis

According to Kolmogorov-Smirnov test, data were normally distributed and therefore, parametric tests were used ($P > 0.05$). Descriptive statistics (frequency, percent, mean, and standard deviation [SD]), independent t-test, chi-square test, Monte Carlo test, Fishers Exact test, Confidence Interval, Relative Risk, and Repeated Measurement were performed to analyze the results. P-Value < 0.05 was considered significant. Data were analyzed using the statistical software SPSS Ver.16.

Results

Characteristics were presented in **table I** and showed that demographic information (age and sex) and duration of surgical procedure were not different between the two groups (P > 0.5) (**Table I**).

Postoperative analgesia, blood loss, BP/S, BP/D and PR in the SA group were significantly lower than the GA group (P < 0.001) (**Table II**).

Independent t-test showed that the pain severity in the SA group was significantly lower than the GA group at different time intervals (P < 0.001) (**Table III**). Repeated measurement analysis showed that the average pain intensity in the groups were significantly different at various intervals (P < 0.001) (**Figure 1**).

At 1, 4, and 8 hours after surgery, the pain severity in GA group was significantly higher than the SA group. In the spinal group the postoperative VAS score at 1 hour was lower than one and stayed low (VAS < 2) at 4 and 8 hours after surgery. This suggests that the SA method has effectively controlled the pain severity (**Figure 1**).

In the SA group, one patient (4%) experienced vomiting, while eight patients (32%) in the general group experienced vomiting. The incidence of vomiting in the GA group was eight times more than the SA group (RR=8, 95% CI= 1.08-58.8). **Table II** shows that the incidence of nausea and shivering in the SA group was significantly lower than the GA group, but the incidence of headache after surgery in the GA group was significantly lower than the SA group (P < 0.05) (**Table IV**/ **Figure 2**).

Table I: Comparison of baseline characteristics and surgery duration of patients in spinal and general groups.

Patients Characteristics	Spinal group(n=25)	General group (n=25)	P- value
Age / year (mean ±sd)	50±4.7	51±5.3	0.40
Sex M/F n(%)	20 (80%)/5(20%)	19(76%)/6(24%)	0.90
Surgery duration/min (mean ±sd)	83.6±3.6	85.4±3.3	0.05

Table II: Postoperative outcomes in the two groups.

Patients Characteristics	Spinal group(n=25)	General group (n=25)	P- value
Anesthesia duration/ min (mean ±sd)	115.6±11.8	133±9.6	0.000
Recovery time/ min (mean ±sd)	26±11	38±9	0.000
Morphine consumption /mg (mean ±sd)	3.7±1.2	8±2.5	0.000
Blood loos / ml (mean ±sd)	317±10.9	424±5.9	0.000
BPS/ mm (mean ±sd)	115±28	135±47	0.000
BPD/ mm (mean ±sd)	68.6±34	87.4±39	0.000
PR/ per/ min (mean ±sd)	79.6±21	91.8±37	0.000

Table III: Adverse effects in patients in spinal and general anesthesia groups.

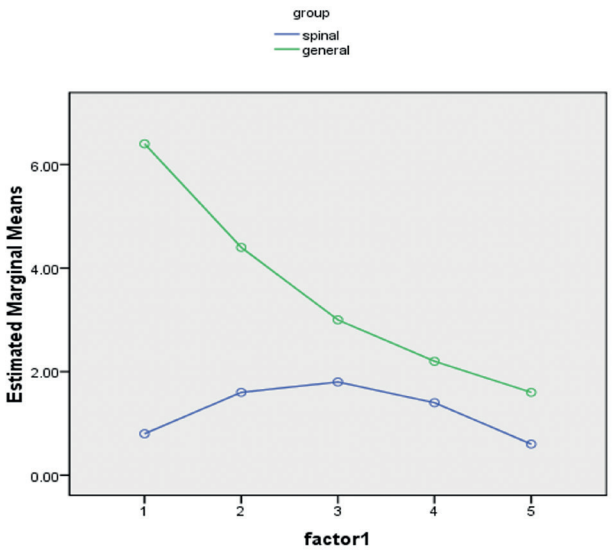
Parameter		Groups		Test	
		General (25), n(%)	Spinal (25), n(%)	RR (95% CI)	p-value
Vomiting	Yes	8 (32)	1 (4)	8 (1.08-58.8)***	0.012*
	No	17 (68)	24 (96)		
Nausea	Yes	12 (48)	3 (12)	4 (1.14-12.5)***	0.005**
	No	13 (52)	22 (88)		
Shivering	Yes	11 (44)	4 (16)	2.75 (1.01-7.46)***	0.031**
	No	14 (56)	21 (84)		
Headache	Yes	2 (8)	15 (60)	7.5 (1.9-29)****	0.001**
	No	23 (92)	10 (40)		
Urinary retention	yes	2 (8)	1 (4)	1.43 (1.09-5.35)***	0.025**
	No	23 (92)	24 (96)	1.85 (1.01-6.45)***	0.046**

*P- value computed using exact test instead of Mont Carlo test ** P- value computed using Chi-square test
*** Spinal group considered as references group **** General group considered as references group

Table IV: Severity of pain at various intervals in spinal and general anesthesia groups.

Pain score by VAS, h	General group (n=25) [M± SD]		Spinal group(n=25) [M± SD]		p-value
1 h after intervention	6.4±0.15		0.8±0.15		0.001
4 h after intervention	4.4±0.16		1.6±0.16		0.001
8 h after intervention	3±0.16		1.8±0.16		0.001
12 h after intervention	2.2±0.09		1.4±0.09		0.001
24 h after intervention	2.2±10	0.6±10	0.001		

Figure 1: Comparison of pain severity between spinal and general group at one, 4, 8, 12 and 24 hours after anesthesia.

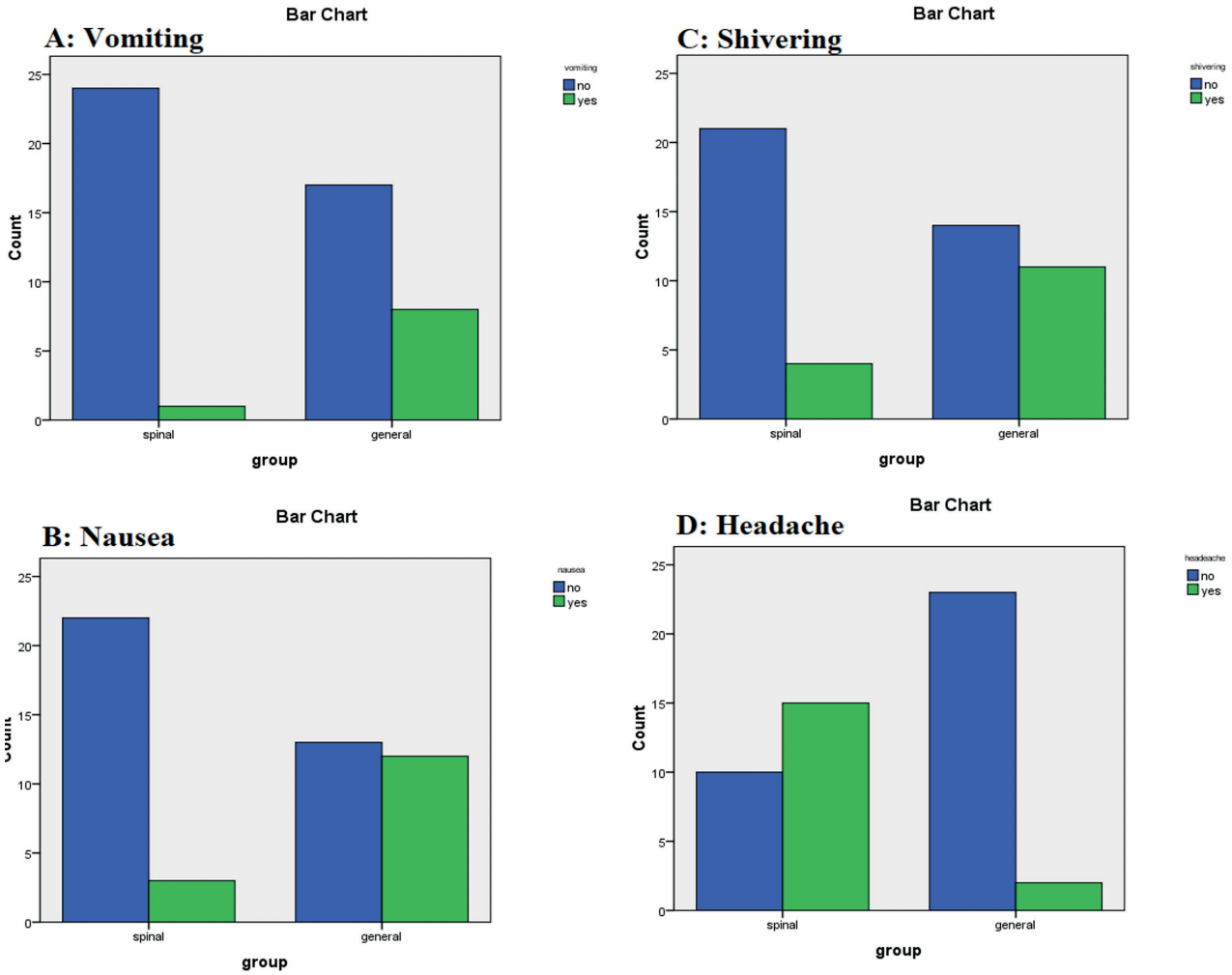


Discussion

Lumbar disc surgery is most commonly performed under general anesthesia. Nevertheless, spinal or epidural anesthesia is also a safe and successful alternative in lumbar surgery[15]. GA may have complications such as postoperative pain, blood loss, nausea, vomiting, and increase in the duration of recovery period[11,16].

The ability to perform long-term surgery in prone position without any airway disruption and patient's satisfaction are the main benefits of using GA[17]. Alternatively, regional anesthesia may decrease the amount of intraoperative blood loss, incidence of pulmonary and cardiac complications. It may decrease peripheral venous pressure to provide appropriate postoperative pain control and may decrease the length of inpatient stays and the overall costs. It may also lead to appropriate postoperative pain control[9-12, 18-21].

Figure 2: Comparison of side effects of general and spinal anesthesia.



Previous medical literature indicates inconsistency regarding the superiority of GA to SA in lumbar surgery. Our results show that patients undergoing lumbar surgery with SA have fewer complications and it has more advantages compared with GA. In addition, the satisfaction of patients and surgeons was significantly higher in SA group compared with GA group, which is consistent with previous studies[11,17,22-24], but inconsistent with the study of Sadrolsadat et al.[14].

Usually patients experience severe pain after lumbar disc surgery[25,26]. The results of previous studies indicate that compared to general anesthesia, spinal anesthesia had less complications in patients who are candidates for disc surgery[11,17,22-24]. In their study among 400 patients undergoing spinal or GA for lumbar disc surgery, McLain et al. (2005) concluded that SA was better and more effective than GA. They showed that SA might lead to reduced incidence of nausea and morphine use, shorter anesthesia duration and fewer adverse effects[22]. Tetzlaff et al. (1998) concluded that SA with fewer adverse effects could be determined as an effective alternative to GA for lumbar surgery[23]. Attari et al. (2011) concluded that SA decreases blood loss, BP, HR changes, and postoperative analgesia use. Furthermore, the satisfaction of surgeon and patient was significantly higher in SA group[17].

Demirel et al. (2003) conducted a study among patients undergoing discectomy or laminectomy. They found that epidural anesthesia was more successful than GA with fewer episodes of hypertension and less blood loss[24].

In their study, Khajavi et al (2013) compared GA with combined epidural/GA for lumbar disc surgery, and concluded that patients in combined epidural/GA group had less blood loss, hypotension, lower use of anesthetic medications during surgery, lower prevalence of tachycardia and hypertension and morphine consumption in the recovery room[11].

In their prospective study, Sadrolsadat et al. (2009) concluded that as opposed to previous studies that showed spinal anesthesia was better than general anesthesia for patients under lumbar surgery, SA does not offer any advantage over general anesthesia, and GA has many advantages over SA[14].

The mechanism of less blood loss after SA in lumbar disc surgery is due to two factors. The first mechanism is vasodilatation due to blockade of the sympathetic pathway. The second mechanism is spontaneous ventilation which reduces the intrathoracic pressure and resulting in less dilation of the epidural veins. This is another important factor for less blood loss after SA[17].

In our study, the mean arterial BP and HR changes compared to the baseline value were significantly lower in SA group compared with GA group. This mechanism is due to the better prevention of stress hormones by SA than GA[27-29]. Patients in SA group had less pain and morphine use was significantly lower compared with GA group. Reduction of pain score and morphine use after surgery can be explained by two mechanisms. The first hypothesis is the preventive effect of spinal anesthesia that reduces the pain severity by blockade of the afferent nociceptor sensitization pathway. The second process is possibly the remaining sensory block in spinal anesthesia group. This issue is caused by the delay in sensory recovery following motor recovery[17].

Conclusions

In conclusion, SA is a safe, effective, and successful method compared to GA for patients undergoing lumbar disc surgery. Some advantages of SA include decreasing pain severity score and analgesia use, reduced amount of blood loss during the surgery and fewer postoperative complications.

Limitations

The major limitation of the study was the small sample size, which is tried to be compensated in future studies.

Acknowledgments

We thank Ilam University of Medical Sciences, pa¬tients and all people who participated in this study.

Funding/Support

This study was supported by Ilam University of Medical Sciences (IR. MEDILAM.RE.1394.39) and IRCT2015062222870N1.

Conflict of Interest

There is no conflict of interest.

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